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2 A control system for optimizing deep hole drilling conditions
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Industrial Electronics, Control and Instrumentation, 1991. Proceedings. IECON '91., 1991 International Conference on, 28 Oct.-1 Nov. 1991

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3 A smart bolter for improving entry stability
Howie, W.L.; Frizzell, E.M.;

Industry Applications Society Annual Meeting, 1989., Conference Record of the 1989 IEEE, 1-5 Oct. 1989

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- 319** **BELOW-GROUND MECHANICAL MOTION CONVERTING MEANS RELATIVELY**
MOVING PLURAL CUTTING EDGES
320 **WITH TOOL SHAFT DETAIL**
- 321 . Axially telescoping shaft section
 - 322 .. Telescoping motion related to relative axial rotation or oscillation
 - 323 . Helix or helically arranged structure
 - 324 . Means other than tool structure to induce fluent flow
 - 325.1 . Shaft carried guide or protector
 - 325.2 .. Coupled between shaft sections or bit and shaft section
 - 325.3 ... With bore wall engaging means rotatable relative to shaft section (e.g., with bearings)
 - 325.4 ... Having removable inserts
 - 325.5 .. Surrounding existing shaft section
 - 325.6 ... Held by a fastener parallel to shaft axis
 - 325.7 ... Held by discrete fastening means tangential to shaft axis
 - 326 .. Engaging means advances in adjacent hole
 - 327** **BIT OR BIT ELEMENT**
 - 331 . Rolling cutter bit or rolling cutter bit element
 - 332 .. Core forming-type bit
 - 333 ... With core-breaking means
 - 334 .. Bit with leading cutter forming smaller diameter initial bore
 - 335 ... Leading fixed cutter
 - 336 .. Rolling cutter bit with fixed cutter
 - 337 .. With drilling fluid supply to bearing
 - 338 .. With rotary or endless carrier
 - 339 .. With drilling fluid conduit details
 - 340 ... Fluid conduit lining or element (e.g., slush tube or nozzle)
 - 341 .. Plural rolling cutters with intermeshing teeth
 - 342 .. Adjustable cutter element
 - 343 .. Wobbling cutter
 - 344 .. Noncutting portion forwardly of rolling cutter (e.g., reamer)
 - 345 ... Longitudinal axis cutter
 - 346 Separable support for cutter axle
 - 347 Removable axle or bushing
 - 348 .. Longitudinal axis cutter
 - 349 ... With transverse axis cutter
 - 350 .. Laterally offset cutter axis
 - 351 ... Disk blade
 - 352 Plural coaxial cutters
 - 353 ... Cone or frustum rolling cutter
 - 354 .. Axle rotatable with cutter
 - 355 .. Circumferentially displaced cutter axes
 - 356 ... Stub axle only
 - 357 ... Detachable multiaxis support or spider
 - 358 ... Mutually contacting cutter supports
 - 359 With bearing or seal details
 - 360 .. Cross axle with stub axle
 - 361 .. Cross axle
 - 362 ... Vertically disaligned cross axle sections
 - 363 ... Separable supports
 - 364 ... Removable cross axle or bushing

- 365 .. Outwardly directed stub axle
- 366 .. Separable support for stub axle
- 367 .. Detachable stub axle, bushing or bearing
- 368 ... Releasable cutter securing device
- 369 .. Stub axle cutter securing means
- 370 ... Released by antifriction bearing disassembly
- 371 .. With bearing or seal details
- 372 ... Antifriction type
- 373 .. Disk cutter
- 374 .. Specific or diverse material
- 375 ... Welded
- 376 .. Nonsymmetrical bit (e.g., nontracking)
- 377 .. ~~Spiral rib or tooth row~~
- 378 .. Irregular tooth cutter row
- 379 . Cutting edge self-renewable during operation
- 380 . Unsupported abrading particle type (e.g., shot)
- 381 . Cutting edges relatively longitudinally movable during operation
- 382 . Adjustable cutter element
- 383 .. Adjustment presents different cutting edge
- 384 .. Radially adjustable
- 385 . Bit with leading portion (e.g., pilot) forming smaller diameter initial bore
- 386 .. Leading portion is separable starter
- 387 .. Leading portion is core forming type
- 388 .. Leading portion is a screw
- 389 .. Impact type
- 390 ... Plural larger diameter steps
- 391 .. Plural larger diameter steps
- 392 .. Leading portion is forked rotary type
- 393 . With fluid conduit lining or element (e.g., slush tube)
- 394 . With helical-conveying portion
- 395 .. Impact type
- 396 . Axially parallel side wall with transverse cuttings retaining portion
- 397 . Forked rotary nontracking
- 398 . Nonsymmetrical bit
- 399 .. With bore wall engaging guide
- 400 .. Nonsymmetrical arrangement of opening for cuttings or fluid
- 401 . Cutting edges facing in opposite axial directions
- 402 . Casing shoe type
- 403 . Core forming type
- 404 .. With core-breaking means
- 405 .. Impact or percussion type
- 405.1 .. Includes diamond
-
- 406 . Noncutting portion forwardly of cutting portion (e.g., reamer)
- 407 .. Impact type
- 408 . With bit guide or bore wall compacting device
- 412 . Plural separable cutter elements
- 413 .. Independently attachable
- 414 . Impact or percussion type
- 415 .. Combined with rotary
- 416 .. Noncircular bore cutter
- 417 .. With internal-fluid passage
- 418 ... Plural openings
- 419 ... Cruciform
- 420 .. Cruciform
- 420.1 .. Insert

- 420.2 ... Includes diamond
- 421 . Symmetrical forked rotary type (e.g., fishtail)
- 328 . Magnetized or with magnet
- 425 . Specific or diverse material
- 426 .. Insert
- 427 ... For a mine roof drill bit type
- 428 ... Preformed cutting element (e.g., compact) mounted on a distinct support (e.g., blank, stud, shank)
- 429 Including a nozzle
- 430 Having a noncircular or nonplanar cutting face
- 431 Having a particular orientation or location
- 432 With support detail
- 433 Having a specified thermal property
- 434 .. Diamond
- 435 .. Welded, brazed, or soldered
- 424 **MISCELLANEOUS (E.G., EARTH-BORING NOZZLE)**
- 423 **WEDGING SLIP ASSEMBLY FOR SUPPORTING A PIPE OR ROD**

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Class 175 BORING OR PENETRATING THE EARTH

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- 1** **WITH SEISMIC SHOCK GENERATING**
- 2** **BORING WITH EXPLOSION IN INACCESSIBLE HOLE**
- 3** . Severing formed core by explosion
- 3.5** . Explosive charge carried by projectile
- 4** . Driving core receiver by explosion or with receptacle collecting material in bore
- 4.5** . Directing successive projectiles or charges in same path
- 4.51** . With position orienting or indicating
- 4.52** . With wall engaging packer or anchor
- 4.53** . Firing chamber movable in bore relative to carrier or another firing chamber
- 4.54** . With bore condition firing control, or compensating means
- 4.55** . Independent firing of plural charges
- 4.56** . Firing control mechanically actuated in bore
- 4.57** . Projectile forms bore
- 4.58** .. With means to initially restrain projectile for pressure build-up
- 4.59** .. With means to prevent preliminary bore fluid contact
- 4.6** . Concave-shaped charge
- 5** **BORING A SUBMERGED FORMATION**
- 6** . Boring with underwater tool drive prime mover
- 7** . Boring from floating support with submerged independent anchored guide base
- 8** . Boring from submerged buoyant support
- 9** . Boring from nonbuoyant support
- 10** . Boring with submersible vertically movable guide
- 11** **BORING BY DIRECTLY APPLYING HEAT TO FLUIDIZE OR COMMUNUTE**
- 12** . Combustion of the formation material
- 13** . With introduction of slag forming flux
- 14** . Combustion is confined chamber having restricted discharge orifice
- 15** . Rotating the heating tool
- 16** . Electrically produced heat
- 17** **WITH HEATING OR COOLING (1) WITHIN THE BORE, OR (2) DRILLING FLUID**
- 18** **ICE BORING**
- 19** **BORING WITHOUT EARTH REMOVAL (I.E., COMPACTING EARTH FORMATION)**
- 20** . Combined with earth removal (e.g., removing sample)
- 21** . Fluid passage to exterior of drive point
- 22** . Drive point detached from shaft to form cased bore or with installation of casing
- 23** .. Drive point retracted through shaft or casing
- 24** **AUTOMATIC CONTROL**
- 25** . Of fluid pressure below ground
- 26** . Of boring means including a below-ground drive prime mover
- 27** . Of advance or applied tool weight
- 38** . In response to drilling fluid circulation
- 39** **WITH BIT WEAR SIGNAL GENERATING**
- 40** **WITH SIGNALING, INDICATING, TESTING OR MEASURING**
- 41** . Ray energy detection or measuring
- 42** . Indicating agent released in drilling fluid
- 44** . Providing identifiable indication of core position in situ for core sample orientation

- 45 . Tool position direction or inclination measuring or indicating within the bore
- 46 . Signaling or indicating condition of cutting in cuttings retainer
- 48 . Measuring or indicating drilling fluid (1) pressure, or (2) rate of flow
- 49 . Transparent inspection feature
- 50 . Indicating, testing or measuring a condition of the formation
- 51 **WITH SELF-ACTING CYCLIC ADVANCE AND RETRACTION OF TOOL OR TOOL SHAFT**
- 52 **WITH MAGAZINE FOR SUCCESSIVELY MOVING UNCONNECTED, ORIENTED TOOL OR SHAFT SECTIONS TO USE POSITION**
- 53 **ENLARGEMENT OF EXISTING PILOT THROUGHBORE REQUIRING ACCESSIBILITY TO EXISTING OPPOSITE BORE ENDS TO INSERT AND REMOVE TOOL**
- 54 **BORING BY BELOW GROUND RECIRCULATION OF UNSUPPORTED ELEMENTS (E.G., SHOT)**
- 55 **TOOL ACTUATION BY REACTION OF ROTATING ECCENTRIC MASS**
- 56 **NATURAL VIBRATION CHARACTERISTIC OF AN ELEMENT OF BORING MEANS RELATED (1) TO NATURAL VIBRATION CHARACTERISTIC OF ANOTHER ELEMENT, OR (2) TO FREQUENCY OF AN IMPOSED MOTION PROCESSES**
- 57 **PROCESSES**
- 58 . Sampling of earth formations
- 59 .. Retaining fluid or taking separate fluid sample
- 60 .. Transporting sample to surface by fluid
- 61 . Boring curved or redirected bores
- 62 . Boring horizontal bores
- 64 . Chemical reaction with earth formation or drilling fluid constituent
- 65 . Boring with specific fluid
- 66 .. Treating spent or used fluid above ground
- 67 .. Boring by fluid erosion
- 68 .. Anti-agglomeration treatment of gaseous drilling fluid
- 69 .. Combined liquid and gaseous fluid
- 70 .. Plural distinguishable liquids
- 71 .. Gaseous fluid or under gas pressure
- 72 .. Prevention of lost circulation or caving
- 73 **MEANS TRAVELING WITH TOOL TO CONSTRAIN TOOL TO BORE ALONG CURVED PATH**
- 74 . Sectional guide or shaft having means to lock sections in angular relation while boring
- 75 . Normally curved guide or shaft
- 76 . Axially spaced opposed bore wall engaging guides
- 77 **SIDE WALL TOOL FED Laterally WITHOUT ROTATION FROM INACCESSIBLE HOLE**
- 78 **MEANS CARRIED BY HOUSING INSERTABLE IN INACCESSIBLE HOLE TO ADVANCE SIDE WALL TOOL Laterally**
- 79 **TOOL SHAFT ADVANCED RELATIVE TO GUIDE INSERTABLE IN INACCESSIBLE HOLE TO CHANGE DIRECTION OF ADVANCE**
- 80 . Tool telescopes over guide having surface set at angle in hole
- 81 . With anchor for guide engaging hole side wall
- 82 . Guide carried by shaft to operative position
- 83 .. With clutch means acting between shaft and guide
- 84 **WITH ABOVE-GROUND CLEANER FOR BORING MEANS**
- 85 **WITH ORIENTING OR RACKING MEANS FOR UNCONNECTED TOOLS OR SECTIONS OF SHAFT OR CASING**
- 86 **WITH BELOW-GROUND PERSONAL ACCOMMODATION**
- 87 **CONVERTIBLE**
- 88 **WITH MEANS CARRYING CUTTINGS Laterally OF BORE AXIS COMPRISING (1) CHUTE, (2) CONVEYER, OR (3) VEHICLE**

<u>89</u>	TOOL ELEMENT OR CONTINUOUSLY DRIVEN FLEXIBLE OR ARTICULATED ENDLESS MEMBER
<u>90</u>	. Flexible or articulated member carried on support swingable or laterally movable relative to bore axis
<u>91</u>	BORING MEANS INCLUDING A CONTINUOUSLY ROTATING BIT DESCRIBING A NONCIRCULAR CROSS-SECTIONAL BORE
<u>92</u>	WITH BELOW-GROUND TOOL DRIVE PRIME MOVER
<u>93</u>	. Below-ground (1) generation of motive fluid, or (2) storage of motivating energy
<u>94</u>	. With below-ground feed means
<u>95</u>	. Plural below-ground drive prime movers
<u>96</u>	.. Plural cutter elements driven by individual prime movers
<u>97</u>	. With means to anchor prime movers support to bore wall
<u>98</u>	.. Expansible anchor
<u>99</u>	... Fluid-operated
<u>100</u>	. Discharge passage for motive fluid directed toward bore entrance
<u>101</u>	. With positive connection between tool and support shaft for rotary below ground motor
<u>102</u>	. With below-ground conveyer or impeller for removal of cuttings
<u>103</u>	. With above-ground means
<u>104</u>	. Electric
<u>105</u>	.. Reciprocating
<u>106</u>	. With mechanical motion-converting means
<u>107</u>	. Fluid rotary type
<u>108</u>	COMMON DRIVE OR ADVANCING MEANS FOR CONCURRENTLY BORING ALONG LATERALLY SPACED AXES
<u>113</u>	WITH MEANS TO SIMULTANEOUSLY FEED AND ROTATE TOOL FROM A SINGLE MECHANICAL ELEMENT
<u>114</u>	. Constant rotation rate permitted regardless of (1) release of feed force, or (2) change in feed rate
<u>118</u>	. With feed anchor in earth wall being bored
<u>121</u>	. Rotary drive for relatively advancing feed screw
<u>122</u>	WITH MEANS TO FEED DRIVE
<u>135</u>	WITH ABOVE-GROUND MEANS TO IMPACT AN EARTH-PENETRATING MEANS
<u>161</u>	WITH ABOVE-GROUND MEANS TO MOVE TOOL TO A DUMPING LOCATION OFFSET FROM BORE
<u>162</u>	WITH ABOVE-GROUND MEANS TO FEED TOOL
<u>170</u>	WITH TOOL DRIVE PRIME MOVER OR ABOVE-GROUND MECHANICAL MOTION CONVERTING DRIVE MEANS
<u>171</u>	. With installing casing
<u>172</u>	. With endless flexible conveyer
<u>173</u>	. With diversely operated shafts extending into bore
<u>189</u>	. Drive reciprocates tool
<u>195</u>	. Rotary drive for a relatively advancing tool (e.g., rotary table)
<u>202</u>	ABOVE-GROUND MEANS FOR RELATIVELY MOVING BELOW-GROUND TOOL ELEMENTS
<u>203</u>	WITH ABOVE-GROUND MEANS TO ADVANCE OR RETRACT BORING MEANS
<u>205</u>	WITH MEANS PROVIDING PRESSURIZED GAS CONTACT WITH DRILLING LIQUID
<u>206</u>	WITH ABOVE-GROUND MEANS FOR PREPARING OR SEPARATING DRILLING FLUID CONSTITUENTS
<u>207</u>	WITH ABOVE-GROUND MEANS FOR HANDLING DRILLING FLUID OR CUTTING
<u>208</u>	. Fluid spray
<u>209</u>	. Fluid or cuttings directing or receiving means engaging bore entrance
<u>210</u>	.. Anchored to bore wall
<u>211</u>	.. Axially supported by tool shaft
<u>212</u>	. Pressurized gas supply
<u>213</u>	. With suction pump inlet communicating with bore bottom

- 214 . Fluid head on tool shaft having lateral port and axial passage with seal for means reciprocable in the head
- 215 . With tool shaft having plural passages for drilling fluid
- 216 . Standpipe
- 217 . With pump
- 218 . With valve
- 219 **WITH PARTICULAR ACCOMMODATION FOR PERSONNEL (E.G., SEAT OR PROTECTOR)**
- 220 **WITH ABOVE-GROUND GUIDE FOR RELATIVELY ADVANCING TOOL**
- 226 **WITH SAMPLE COVERING OR COATING MEANS (1) DISPENSED INTO SAMPLE RECEIVER, OR (2) FLUENT**
- 227 **WITH STORAGE MEANS FOR BIT LUBRICANT CARRIED BY BIT OR SHAFT**
- 228 . With fluid pressure-actuated feed means
- 229 . Rotation of bit actuates lubricant feed means
- 230 **WITH EXPANSIBLE BORE WALL ANCHOR (E.G., PACKER)**
- 231 **WITH MEANS MOVABLE RELATIVE TO TOOL BELOW GROUND TO CONTROL ECCENTRIC FLUID EMISSION**
- 232 **WITH MEANS MOVABLE RELATIVE TO TOOL BELOW GROUND TO STOP FLOW TOWARD BORE BOTTOM**
- 233 . Movable to seal sample receiver at bore bottom pressure
- 234 . With longitudinally spaced valve seats
- 235 .. Seat engaged to stop upward flow
- 236 . In sample receiver removable through below-ground tool shaft
- 237 . Means comprises dropped element
- 238 . Flow-stopping means includes relatively movable cutter element
- 239 . With undisturbed core receiver
- 240 .. Movable means adapted to underlie severed core
- 241 . Stops flow by movement about fixed pivot
- 242 .. Pivot transverse to tool axis
- 243 . Resiliently biased or composed of flexible material
- 244 **WITH MEANS MOVABLE RELATIVE TO TOOL TO RECEIVE, RETAIN, OR SEVER UNDISTURBED CORE**
- 245 . Core bit closure relative upwardly movable by core
- 246 . Receiver removable through below-ground tool shaft
- 247 .. With fluid pressure-responsive means to remove receiver or operate latch
- 248 .. Core forming cutting edge or element on receiver
- 249 . Core-retaining or severing means
- 250 .. Fluid-actuated
- 251 .. Actuated upon relative movement between tool and tool shaft
- 252 ... Relative rotary movement
- 253 .. With element holding retaining or severing means inactive
- 254 .. Mounted on transverse pivot
- 255 .. Sliding wedge type (e.g., slips)
- 256 **WITH RELEASABLE MEANS NORMALLY HOLDING JOINTED SHAFT SECTIONS IN ANGULAR RELATION**
- 257 **TOOL REMOVABLE OR INSERTABLE THROUGH OR AROUND DRIVING OR DRIVEN SHAFT OR CASING**
- 258 . Laterally shiftable cutter element movable through shaft
- 259 .. Plural cutter elements longitudinally relatively movable into transverse alignment
- 260 .. Cutter element engages torque transmitting abutment on shaft when expanded
- 261 ... With additional torque transmitting abutment on bit head and shaft
- 262 . Tool movable exteriorly of shaft
- 263 **CUTTER ELEMENT LATERALLY SHIFTABLE BELOW GROUND (E.G., EXPANSIBLE)**
- 264 . With separable means holding tool collapsed above ground only
- 265 . Plural cutter elements longitudinally relative movable into transverse alignment
- 266 . Plural selectively shiftable cutter elements

- 271 . With latch operated by fluid pressure or dropped element
- 267 . Cutter element shifted by fluid pressure
- 268 .. With dropped element
- 269 .. Fluid pressure acts against spring biased part
- 270 . Cutter element shifted by dropped element
- 272 . Cutter element shifted by relatively longitudinally movable threaded elements
- 273 . Cutter element shifted by cam or gear axially rotatable relative to shaft
- 274 . With shifting mechanism spring biased to operative position
- 275 .. With separate latch
- 276 ... Frangible or discardable element
- 277 ... Latch holds mechanism retracted
- 278 Latch return shifting mechanism to inoperative position
- 279 .. Cam or gear means movable to shift cutter element
- 280 ... With forwardly extending noncutting portion
- 281 .. Cutter element substantially longitudinally movable on shaft
- 282 ... Plural elements expanded into single socket
- 283 ... With forwardly extending noncutting portion
- 284 . Cutter element shifted by longitudinally relatively movable parts
- 285 .. Toggle or linkage between movable parts
- 286 .. Cam or gear engaging cutter element
- 287 ... With separate latch holding cutter element in shifted position
- 288 ... Cutter element substantially longitudinally movable on shaft
- 289 ... Cutter element spring biased to retracted position
- 290 . With latch
- 291 . Spring biased
- 292 . Pivoted about substantially longitudinal axis
- 293 BELOW-GROUND (1) HAMMER, OR (2) IMPACT MEMBERS**
- 294 . Combined with safety joint
- 295 . With noncutting portion forwardly of sleeve impact member having a cutting portion (e.g., reamer)
- 296 . Fluid-operated
- 297 .. Restricted orifice for initially delaying escape of restraining fluid
- 298 . Continuous unidirectional rotary motion of one telescoping member effects consecutive impacts
- 299 . Resiliently biased
- 300 . With releasable means to detachably retain telescoping members against axial reciprocation
- 301 .. Frangible
- 302 .. Condition for release adjustable
- 303 ... Adjustable below ground
- 304 .. Resiliently biased latch
- 305 . Telescoping members relatively rotatable
- 306 .. With means to couple members to prevent relative rotation
- 307 WITH CUTTING EDGE COVER**
- 308 WITH RECEPTACLE**
- 309 . Removable or insertable through below-ground tool shaft
- 310 . With helical conveyer
- 311 . Suspended below bit
- 312 . Sieve or strainer
- 313 WITH MECHANICAL CLEANER FOR BIT OR CUTTER ELEMENT**
- 314 WITH WELL-TYPE SCREEN**
- 315 COMBINED**
- 316 WITH RELATIVELY MOVABLE PARTS TO FACILITATE CLEANING WITHOUT DISASSEMBLY**
- 317 WITH MEANS MOVABLE RELATIVE TO TOOL OR SHAFT TO CONTROL BELOW-GROUND PASSAGE**
- 318 . Valve prevents upward flow